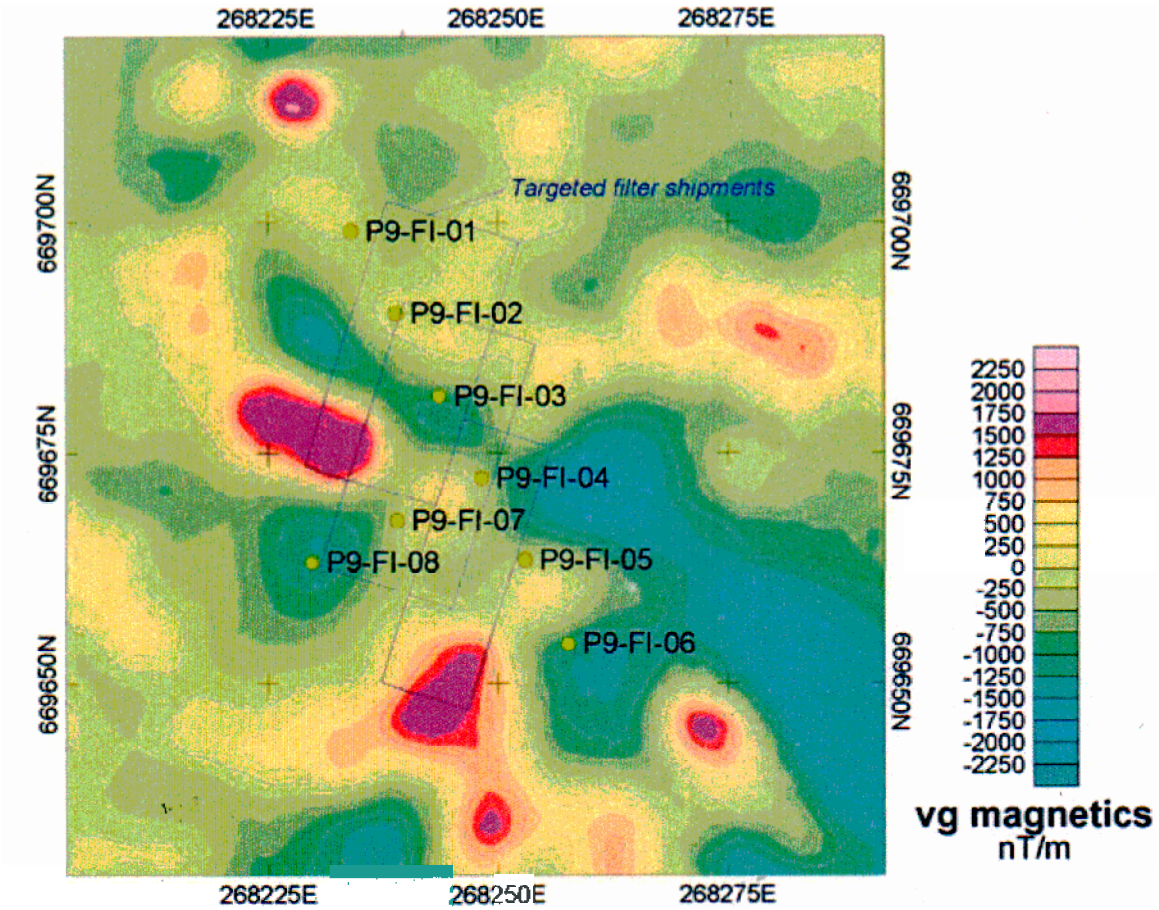

Figure 3-39. Filter Study Area showing probe locations, targeted waste shipments, and surface geophysics.

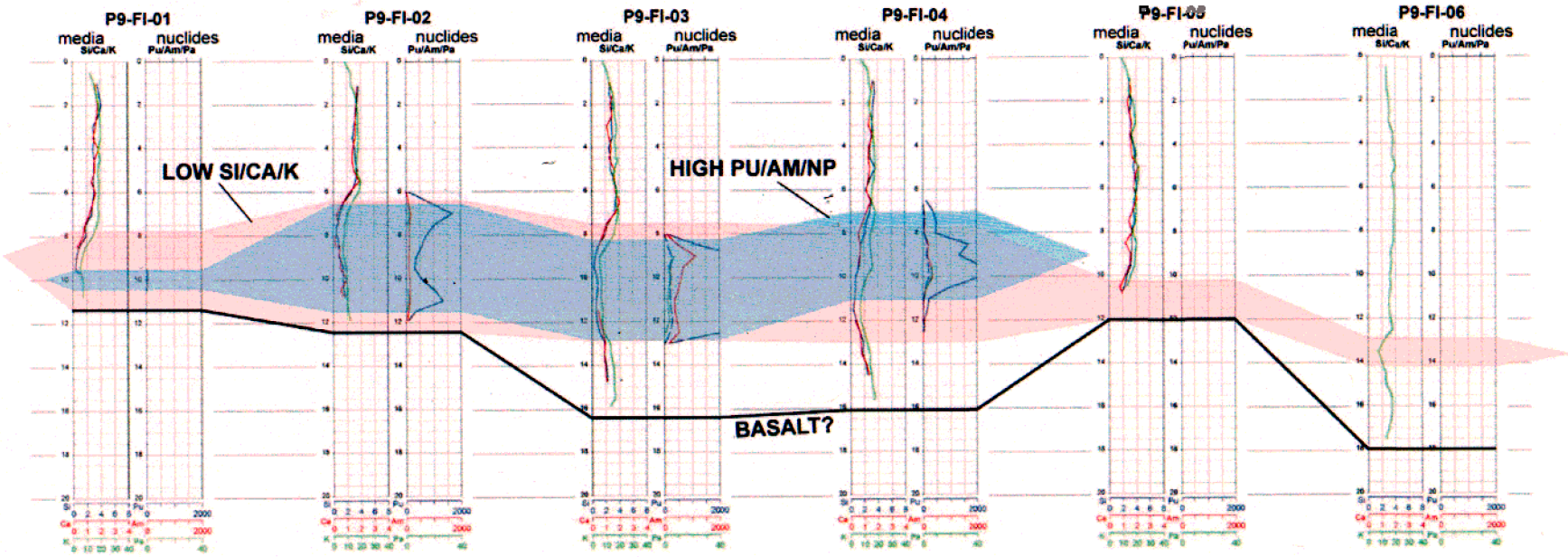

Figure 3-40. Interpretive cross section through filter study area showing correspondence between high nuclides and low soil through Probes P9-FI-02–P9-FI-04.

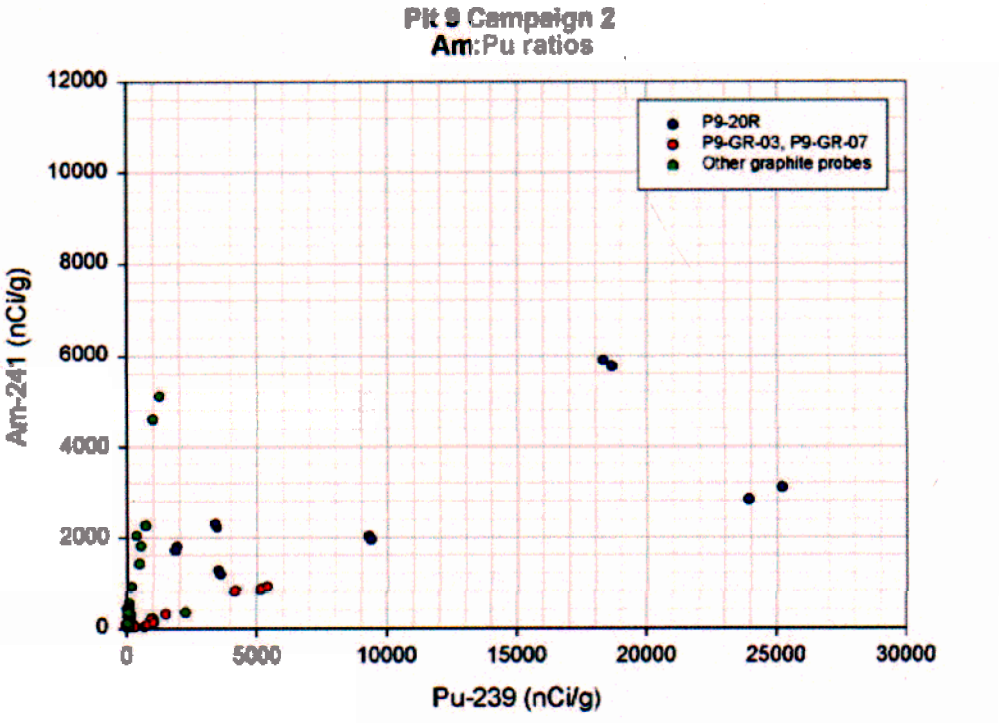

Figure 3-41. Americium:Plutonium data for P9-20 and graphite probes.

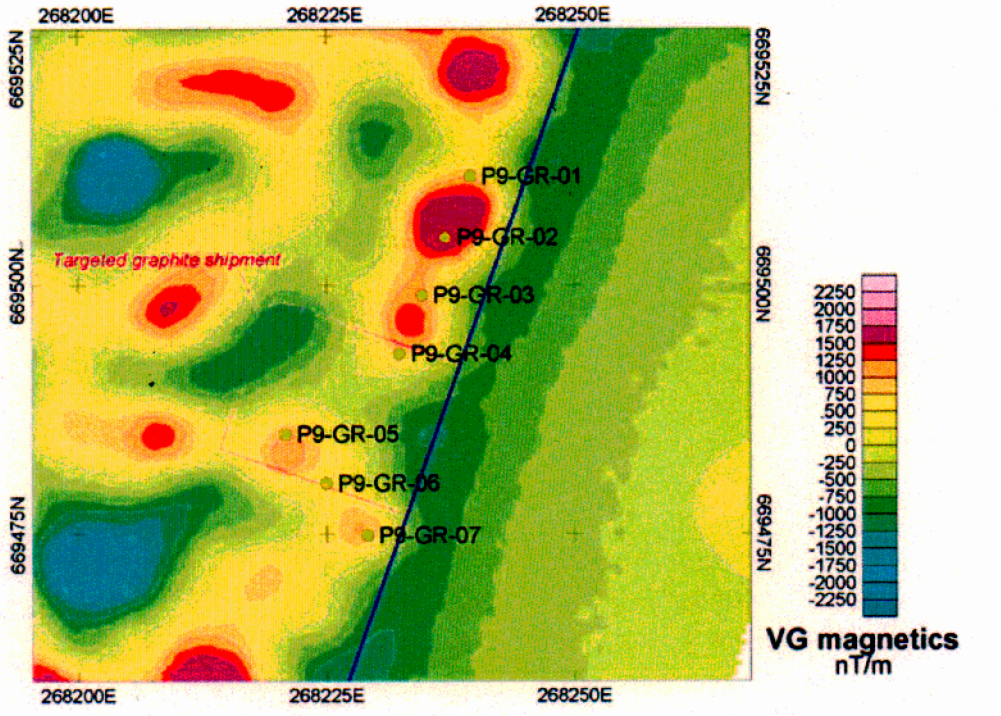

Figure 3-42. Graphite Study Area showing probe locations, targeted waste shipments, and surface geophysics.

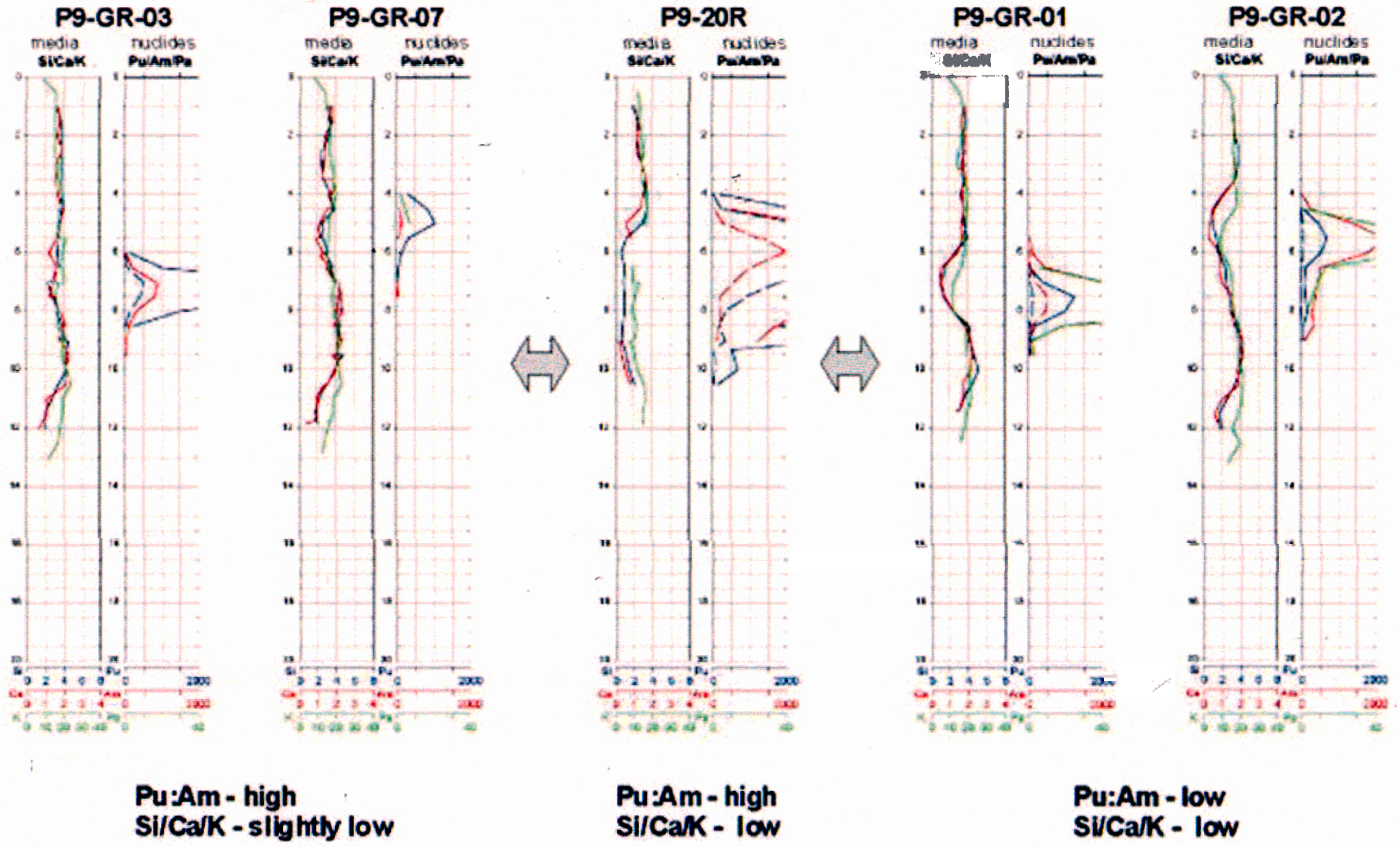

Figure 3-43. Comparison of radionuclide combinations in the Pit 9 Campaign 2 filter exploration area.

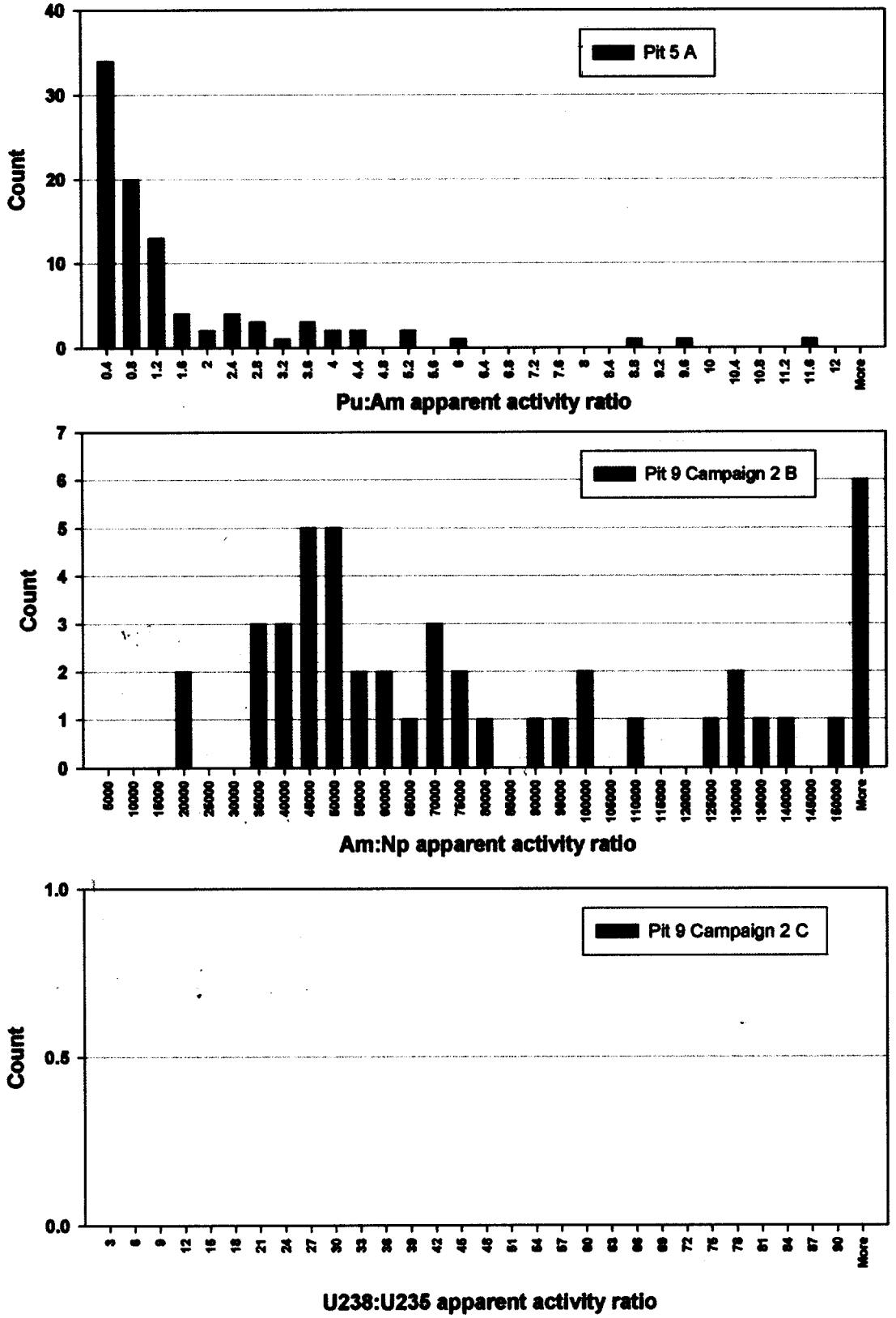

Figure 3-44. Histogram of isotopic ratios for Pit 9 Study Area and Pit 9 Campaign 1 probes.

Table 3-23 shows a comparison between expected and observed Pu, Am, and Np ratios where the expected values are based on 30-year decay of weapons-grade plutonium. The Am:Np ratio suggests an excess of Np relative to the amount expected from pure Am decay.

3.6.2.2 Uranium-235 and Uranium-238. No ^{238}U:^{235}U ratios were obtained from Pit 9 Campaign 2 probe data due to the scarcity of uranium.

Table 3-23. Comparison of expected and observed Pu, Am, and Np activity ratios.

Ratio	Weapons-grade Plutonium	Observed
^{239}Pu:^{241}Am	6.7	<2
^{241}Am:^{237}Np	100,000	35,000–80,000

3.7 West Subsurface Disposal Area Focus Area

The West SDA Focus Area was investigated in order to resolve apparent conflicts between waste inventory records and surface geophysical data and to examine the possibility of identifying specific waste shipments within the narrow disposal trenches that characterize much of the western SDA.

3.7.1 Method

All existing surface geophysical data for the western SDA were compiled on a common datum. Table 3-24 gives specifications for the data sets utilized. The 1992 Ebasco data sets are the primary basis for the interpretations presented in this summary since the high-resolution Sage Earth Science data covers only a small portion of the western SDA trenches (Ebasco 1993; Sage 1999). Figures 3-45 and 3-46 show the compiled magnetic and electromagnetic (EM) induction data for the western SDA.

Inventory records for Trenches 2–10 were reviewed by Mr. Rod Thomas. These records gave position information for each RFP drum shipment. The position information was in the form of a distance range (or in some cases a single distance point) relative to fence posts located on the SDA perimeter to the north and south of the trenches. Position data was used to produce scale plots of the RFP drum shipment sequence for each trench (Figure 3-47). The drum sequence plots were then scanned and scaled to facilitate comparison with the geophysical map data. Note that the absolute positions, zero reference, and azimuth for the perimeter fence posts are unknown.

Both the geophysical data and the inventory records indicate that the trenches contain clusters of metallic waste separated by intermittent, sometimes large, gaps. The principal analysis method used in this investigation was to "match" the RFP drum sequence plots to geophysical anomaly patterns. This method revealed information concerning the likely origin of the fence post coordinate system, allowed positive identification of the trenches, and yielded georeferenced locations for each trench and for some of the individual RFP shipments within the trenches.

Table 3-24. Surface geophysics data sets for the western Subsurface Disposal Area.

Geophysical Subcontractor	Instrument	Year	Data Spacing
Ebasco Environmental	Vertical gradient magnetic field	1992	3.2 × 13.1 ft
Ebasco Environmental	EM31 electromagnetic induction	1992	3.2 × 13.1 ft
Sage Earth Science	Vertical gradient magnetic field	1998	0.5 × 1.6 ft
Sage Earth Science	EM61 electromagnetic induction	1998	0.9 × 3.3 ft

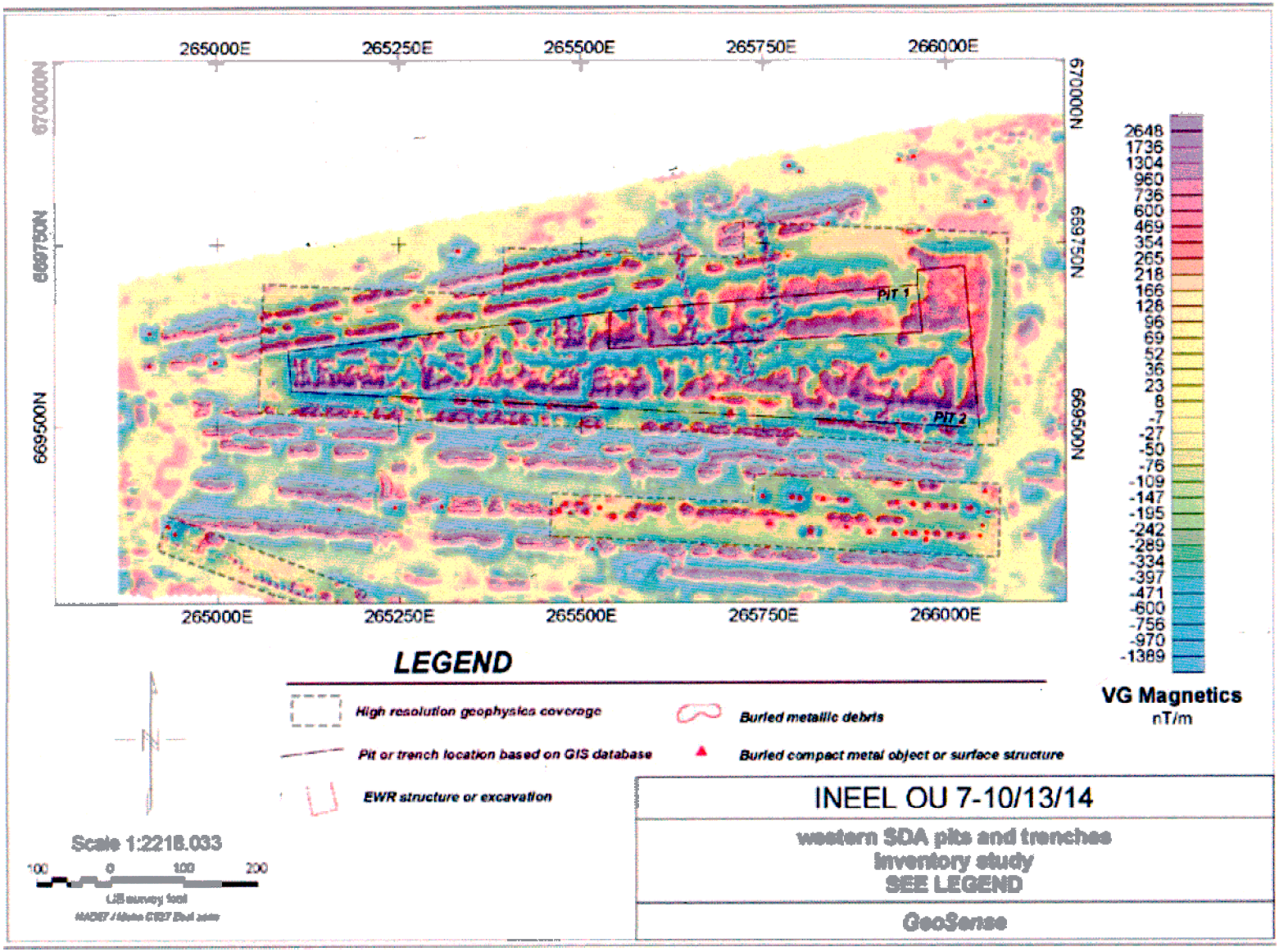

Figure 3-45. Color contour map of vertical gradient magnetic data for the western Subsurface Disposal Area. Annotations show interpreted location of buried metallic debris, metal objects and structures, or excavations that appear to be related to the Early Waste Retrieval project.

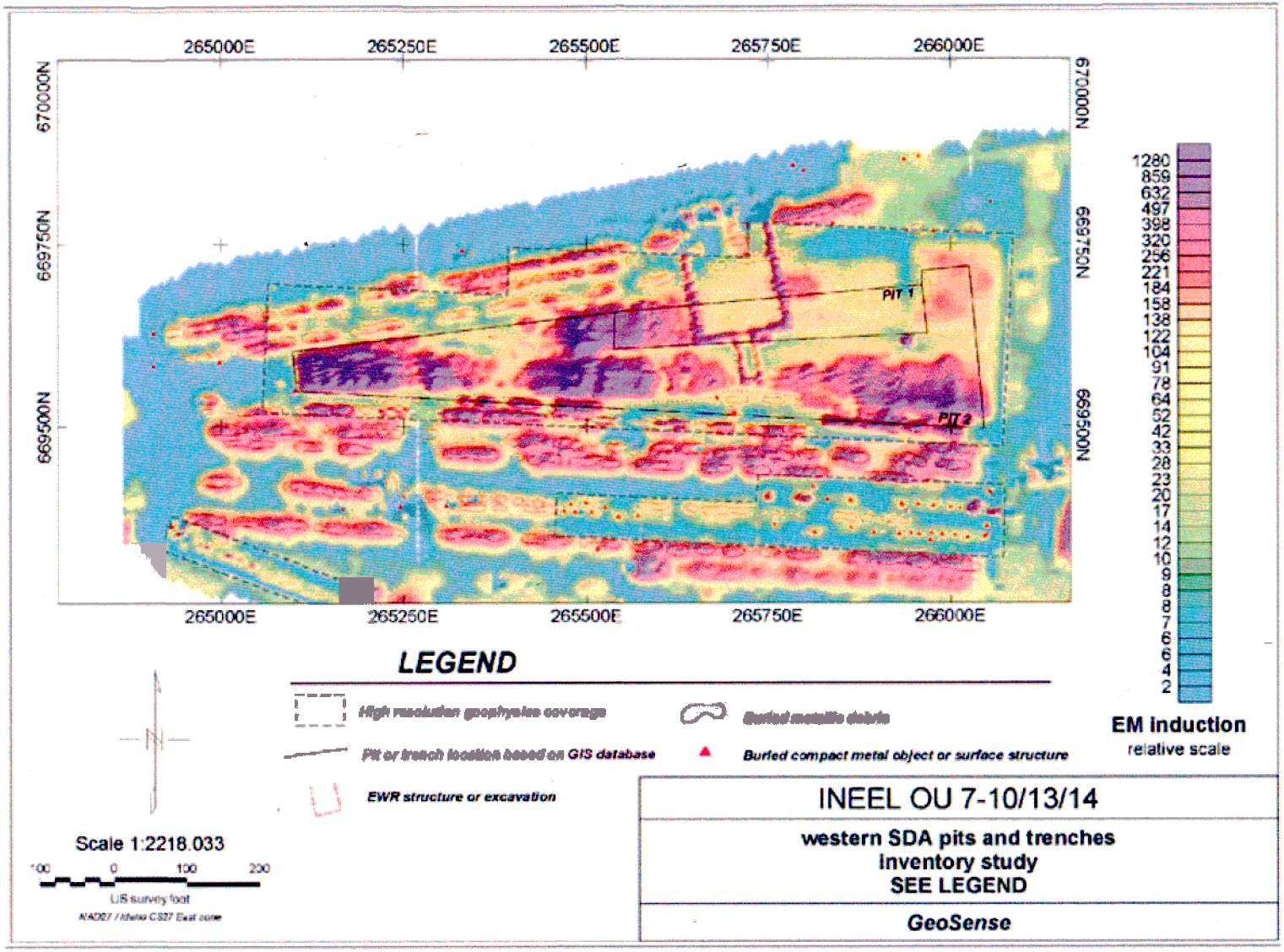

Figure 3-46. Color contour map of electromagnetic induction data for the western Subsurface Disposal Area. Annotations show interpreted location of buried metallic debris, metal objects and structures, or excavations that appear to be related to the Early Waste Retrieval project.

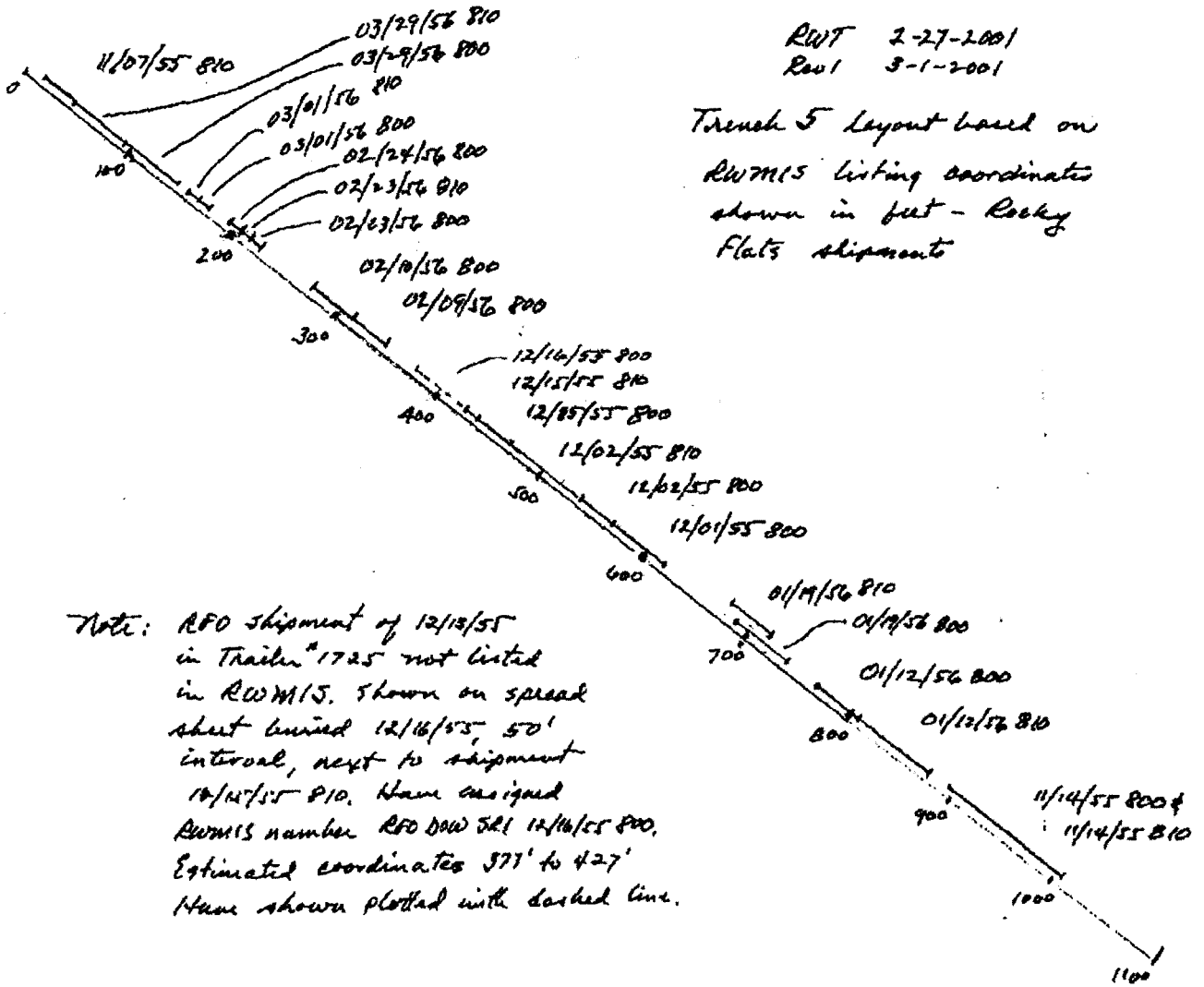

Figure 3-47. Scaled inventory plot for Trench 5.

3.7.2 West Subsurface Disposal Area Conclusions

The following conclusions are based on careful analysis of the surface geophysics data and the waste inventory records:

- The trenches have a simple, straightforward geophysical expression; each trench consists of segments containing concentrated metal debris separated by intervals having little or no metallic waste (Figures 3-45 and 3-46).

- The best match of geophysical anomaly patterns and drum sequence plots was obtained by placing the inventory data origin on the east end of the trenches near the historic eastern trench markers.

- Trenches 2–10 are clearly expressed by the geophysical anomaly patterns. The length, east-west extents, and relative order of these trenches are consistent with geographical information system location data (Figure 3-48).

- The north-south extents of Trenches 2 and 3 are consistent with geographical information system location data. The north-south extents of Trenches 4–10 are shifted north by 5–25 ft from the positions indicated by geographical information system location data (Figure 3-48).

- Inventory data show that Trench 1 contained 2,131 30-gal drums and 713 55-gal drums, yet Trench 1 has no geophysical expression in its historic location north of Trench 5 (Figure 3-48).

- Trenches 3, 4, 5, and 7 have good correspondence between drum sequence plots and geophysical anomaly patterns for the entire trench extents. Individual shipment positions within these trenches may be recognized with good confidence (Figure 3-49).

- Trenches 2 and 8 have good correspondence between drum sequence plots and geophysical anomaly patterns only over a limited extent. Geophysical data indicate additional metallic waste shipments that are not contained in the inventory records (Figure 3-49).

- Trenches 6 and 9 have fair correspondence between drum sequence plots and geophysical anomaly patterns. The geophysical data show additional metallic waste shipments interspersed with the RFP shipments (Figure 3-49).

- The geophysical data indicate several cases where metallic objects occur offset from trench lines or between trenches.

- The final Early Waste Retrieval foundation has a distinct geophysical expression. This foundation intersects Trenches 5, 7, and 9. These trenches do not appear to have been fully cleared of metallic waste by Early Waste Retrieval activities (Figure 3-49).

- Geophysical anomaly patterns suggest two areas that may have been excavated and cleared of metallic debris by Early Waste Retrieval activities. One of these areas intersects Trench 9, and the other area intersects Trench 10 (Figure 3-49).

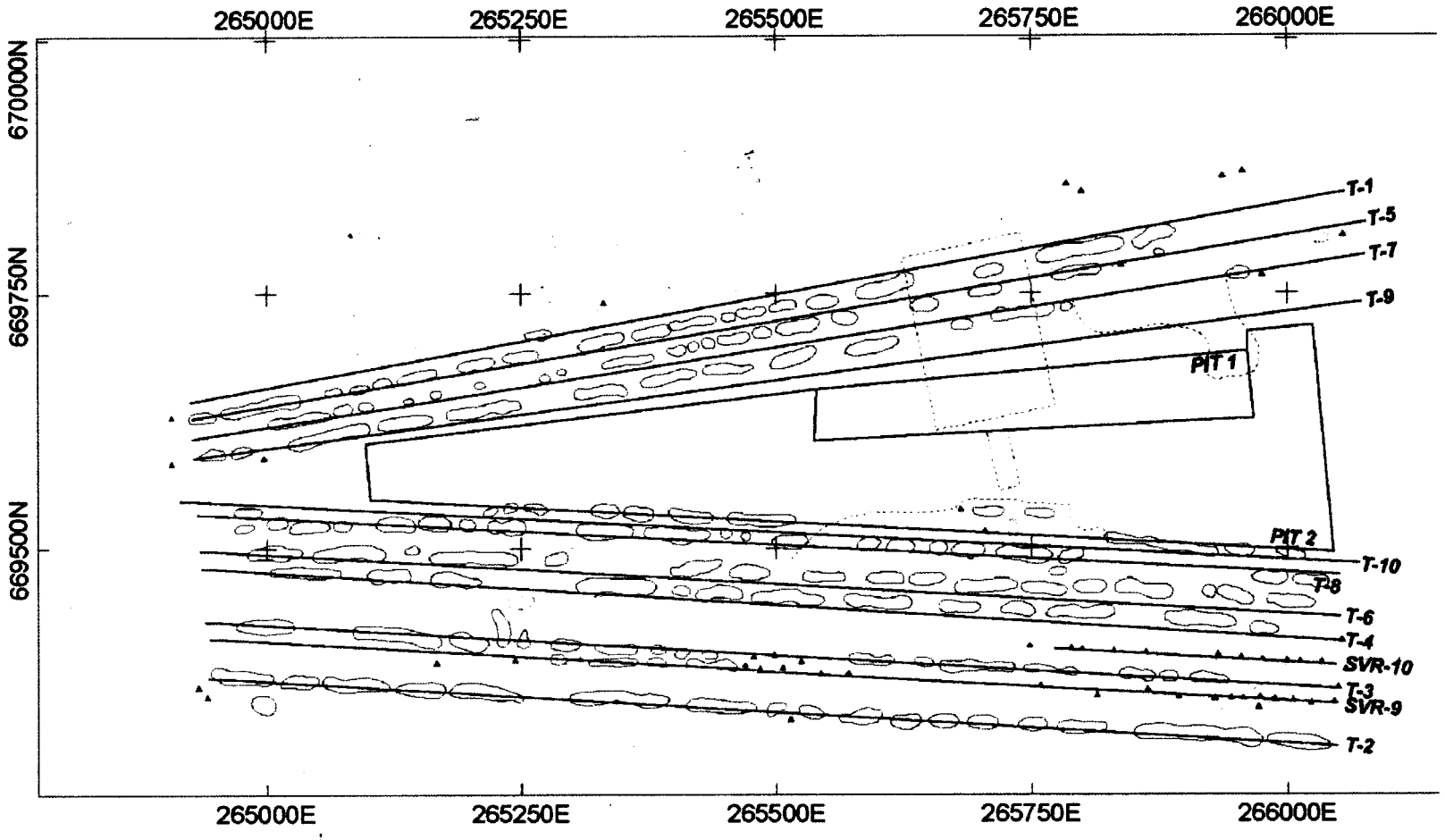

Figure 3-48. Comparison between geophysics interpretation and historic location of western Subsurface Disposal Area trenches.

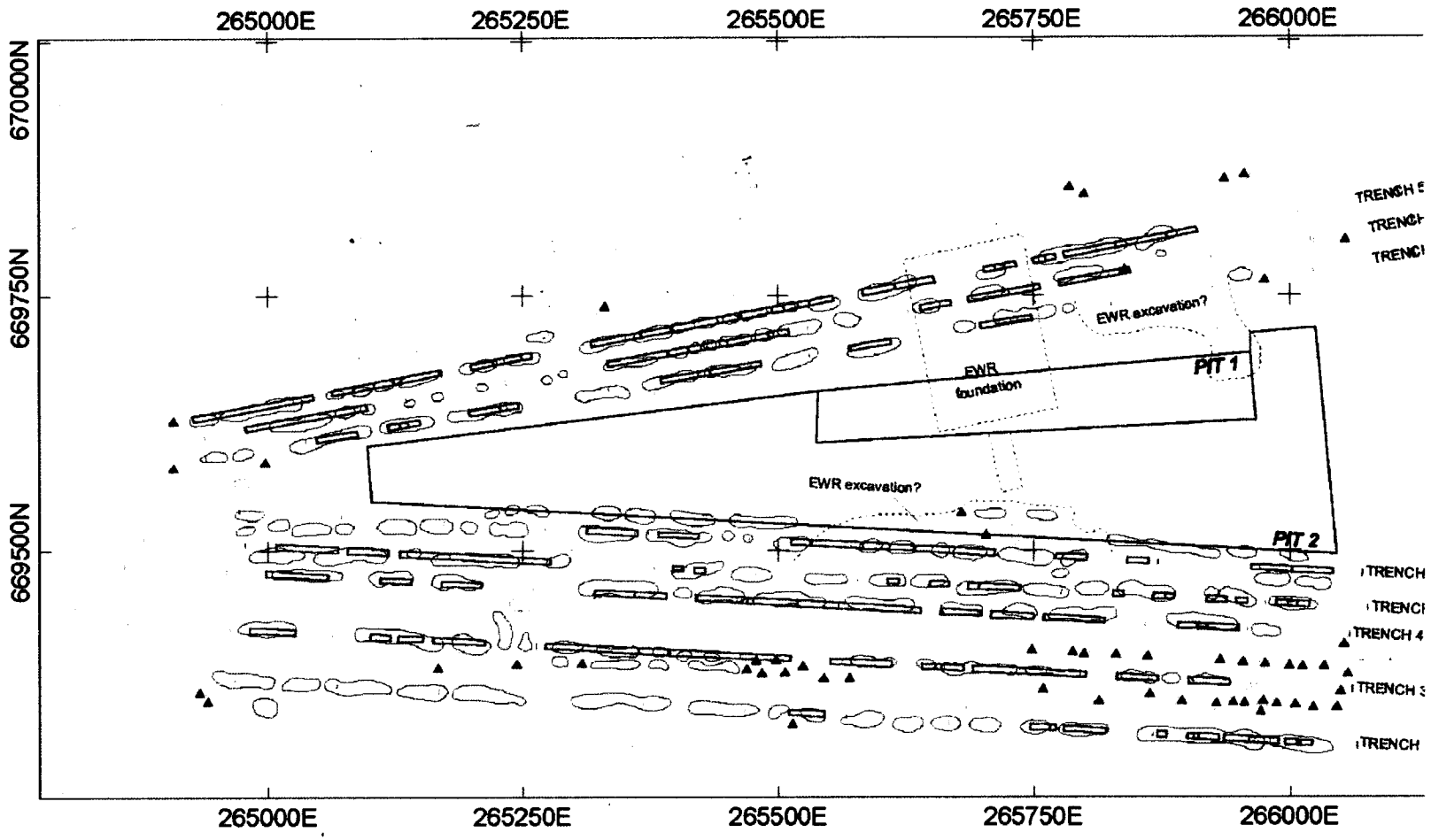

Figure 3-49. Comparison between geophysics interpretation and Rocky Flats Plant drum shipment locations as reconstructed from inventory records.

3.8 Soil Vault Row-12 Focus Area

Irradiated stainless steel reactor components have the potential to disperse C-14 through corrosion processes and are the target for Type B probes in the vicinity of Soil Vault Row-12 (SVR-12). For this purpose, Type B probes are preferably installed in the immediate vicinity of a soil vault containing reactor components. Additional probes (vapor ports) are placed at progressively greater distances from the soil vault in order to evaluate contaminant mobility in the gas phase. Surface geophysical data were evaluated in combination with inventory records to determine the optimum locations for Type B probe installation.

3.8.1 Inventory Records Evaluation

Historical records indicate 15 disposals were made at 10 separate locations along the east end of SVR–12. Seven of the disposal locations are thought to contain irradiated stainless steel targets (listed as from Generator Area CPP603 in Table 3-25). Records provide an approximate location for each disposal location relative to the east end row marker. Due to the approximate nature of the recorded positions and uncertainty regarding the east end marker location at the time of disposal, geophysical data were analyzed to support selection of a specific location to install Type B probes.

3.8.2 Soil Vault Row-12 Surface Geophysics Data Analysis

Figures 3-50 and 3-51 show high-resolution magnetic and electromagnetic EM induction data for the area surrounding SVR-12. Highlights show anomalies that indicate the presence of buried metal objects along the trend of SVR-12. Figures 3-50 and 3-51 also show the recorded positions of the Table 3-25 inventory items relative to the current east end marker (this metal marker is visible as a clear geophysical anomaly in both the magnetic and EM data). The number and spacing of the combined magnetic and EM geophysical anomalies roughly correspond with the number and spacing of recorded disposals.[a] In this analysis, the geophysical anomalies are interpreted to reflect the actual position of the disposals.

Table 3-25. Soil vault descriptions for east end of Soil Vault Row-12.

Generator Area	Locationa	Disposal Date	Volume (m3)	Weight (grams)
CPP603	SVR-12 + 10 ft	05-May-82	0.8213	544,300
CPP603	SVR-12 + 10 ft	20-May-82	0.8213	544,300
CPP603	SVR-12 + 20 ft	02-Jun-82	0.8213	544,300
TRA647	SVR-12 + 20 ft	04-Jun-82	0.8496	317,500
TRA647	SVR-12 + 33 ft	07-Jun-82	0.8496	317,500
TRA647	SVR-12 + 33 ft	08-Jun-82	0.8496	317,500
TRA647	SVR-12 + 44 ft	08-Jun-82	0.8496	317,500
TRA647	SVR-12 + 44 ft	09-Jun-82	0.8496	317,500
CPP603	SVR-12 + 55 ft	21-Jun-82	0.8213	544,300
CPP603	SVR-12 + 55 ft	30-Jun-82	0.8213	544,300
CPP603	SVR-12 + 65 ft	30-Jun-82	0.8213	544,300
CPP603	SVR-12 + 75 ft	08-Jul-82	0.8213	544,300
CPP603	SVR-12 + 85 ft	13-Jul-82	0.8213	544,300
CPP603	SVR-12 + 122 ft	21-Jul-82	0.8213	544,300
CPP603	SVR-12 + 132 ft	28-Jul-82	0.8213	544,300

a. Distance from east end of Soil Vault Row-12 (SVR-12).

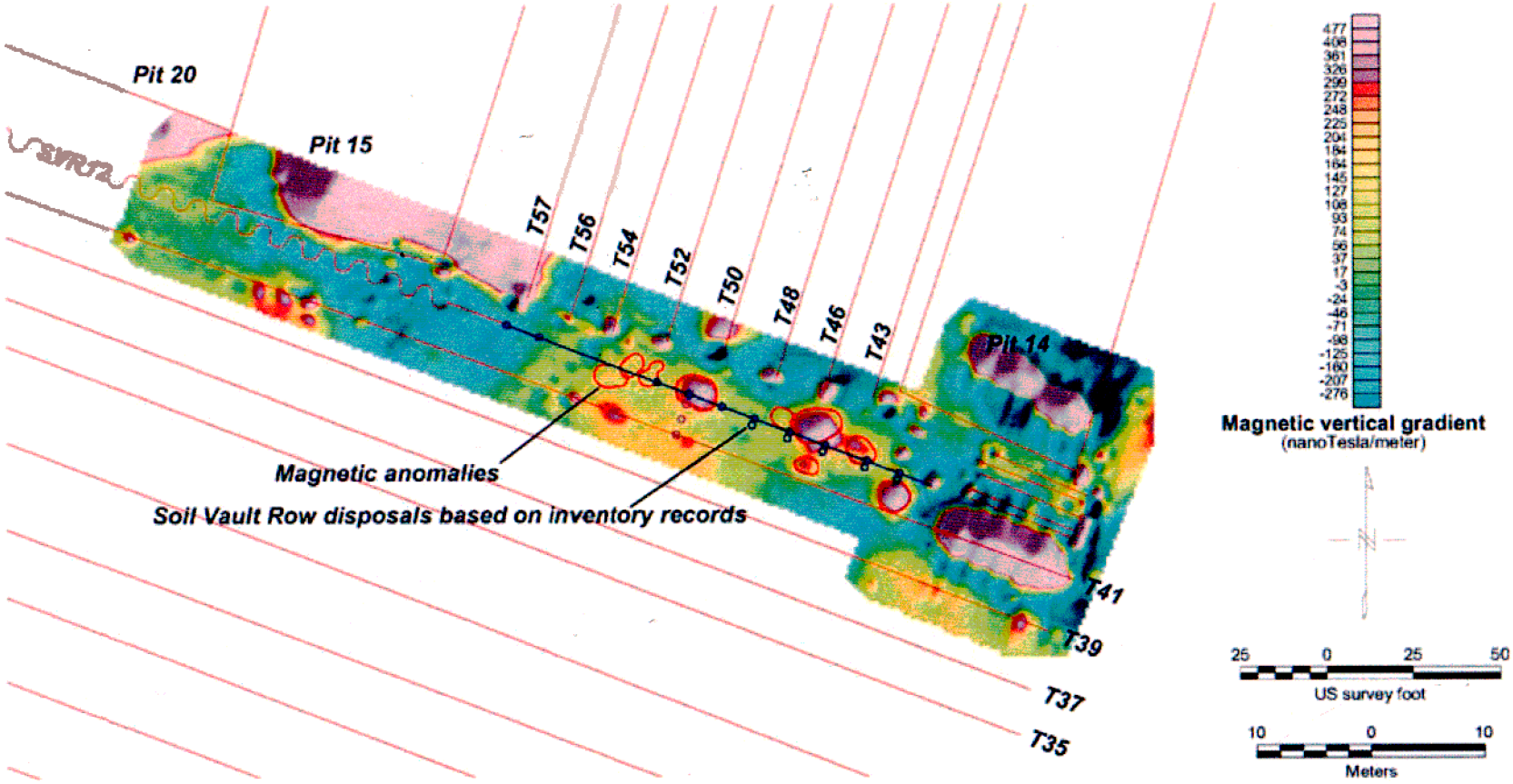

Figure 3-50. Vertical gradient magnetic data for the area surrounding Soil Vault Row-12.

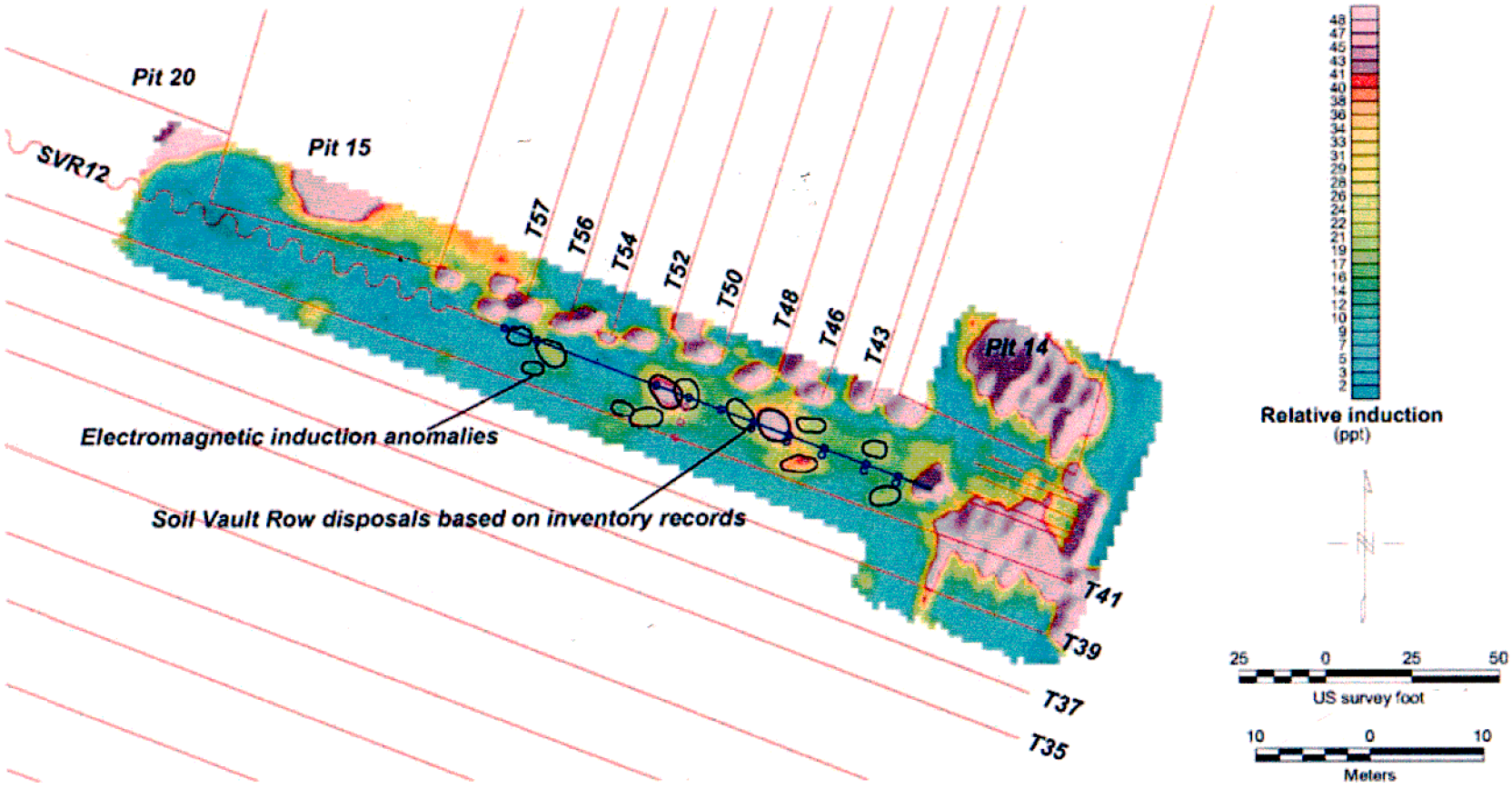

Figure 3-51. Electromagnetic induction data for the area surrounding Soil Vault Row-12.

Figure 3-52 shows a possible association between inventory items and geophysical anomalies. This interpretation is based on the assumption that the current east end marker has not moved since the wastes were buried and recorded in 1982. In making this association, anomalies occurring well off the SVR-12 trend were attributed to Trench 41, with the exception of the anomaly labeled +10. Of particular interest are the group of wastes recorded as disposed from +55 to +85 ft, which are associated with a cluster of magnetic and EM anomalies occurring over a 40-ft interval. The +65 disposal was selected as a preferred target because it has both a magnetic and EM signature and because it falls near the middle of the interval of interest. Although the correlation between inventory and geophysics for this disposal group is imperfect, any one of the disposals within this interval constitutes an acceptable target for Type B probes. Even if the association of inventory and geophysics is off by 10–15 ft, the selected geophysical anomaly would most likely still be associated with an irradiated stainless steel item shipped from CPP603.

3.8.3 Soil Vault Row-12 Recommended Type B Probe Locations

Figure 3-53 shows a detail of the selected target and the proposed Type B probe locations. The radially arranged vapor port probe locations are set at 4.0 ft, 8.6 ft, and 13.2 ft from the center of the targeted soil vault. The closest probes (the first bundle of vapor ports and the lysimeter bundle) are positioned to lie 2 ft outside the edge of a 2-ft radius object representing the assumed waste disposal. The next two radially arranged vapor port probes are at 140 cm (4.6 ft) and 2.80 cm (9.2 ft) from the first probe. The line of vapor port probes was chosen to lie as close to perpendicular to SVR-12 as is consistent with avoidance of metallic waste in adjacent trenches. Remaining probes (i.e., tensiometers, lysimeters, and moisture and geochemical probes) are arranged according to the general requirements specified in the work plan. This is similar to the approach proposed to monitor activated beryllium at SVR-20.

The proposed probe bundle coordinates are given in Table 3-26. Probes used to collect physical samples (i.e., the lysimeters and vapor port probes) are to be arranged such that all probes within the bundle are installed as close as possible to and equidistant from the targeted waste.

Table 3-26. Proposed Type B probe locations.

Probe Bundles	Easting[a]	Northing[a]
SVR-12-1-VP	267,863.0	668,449.9
SVR-12-2-VP	267,866.8	668,452.5
SVR-12-3-VP	267,870.7	668,455.0
SVR-12-1-L	267,858.2	668,443.2
SVR-12-1-T	267,860.1	668,440.9
SVR-12-1-G	267,859.5	668,438.7
SVR-12-1-M	26,786,105	668,439.1

a. Coordinates specified in Idaho State Plane, East Zone, NAD27.

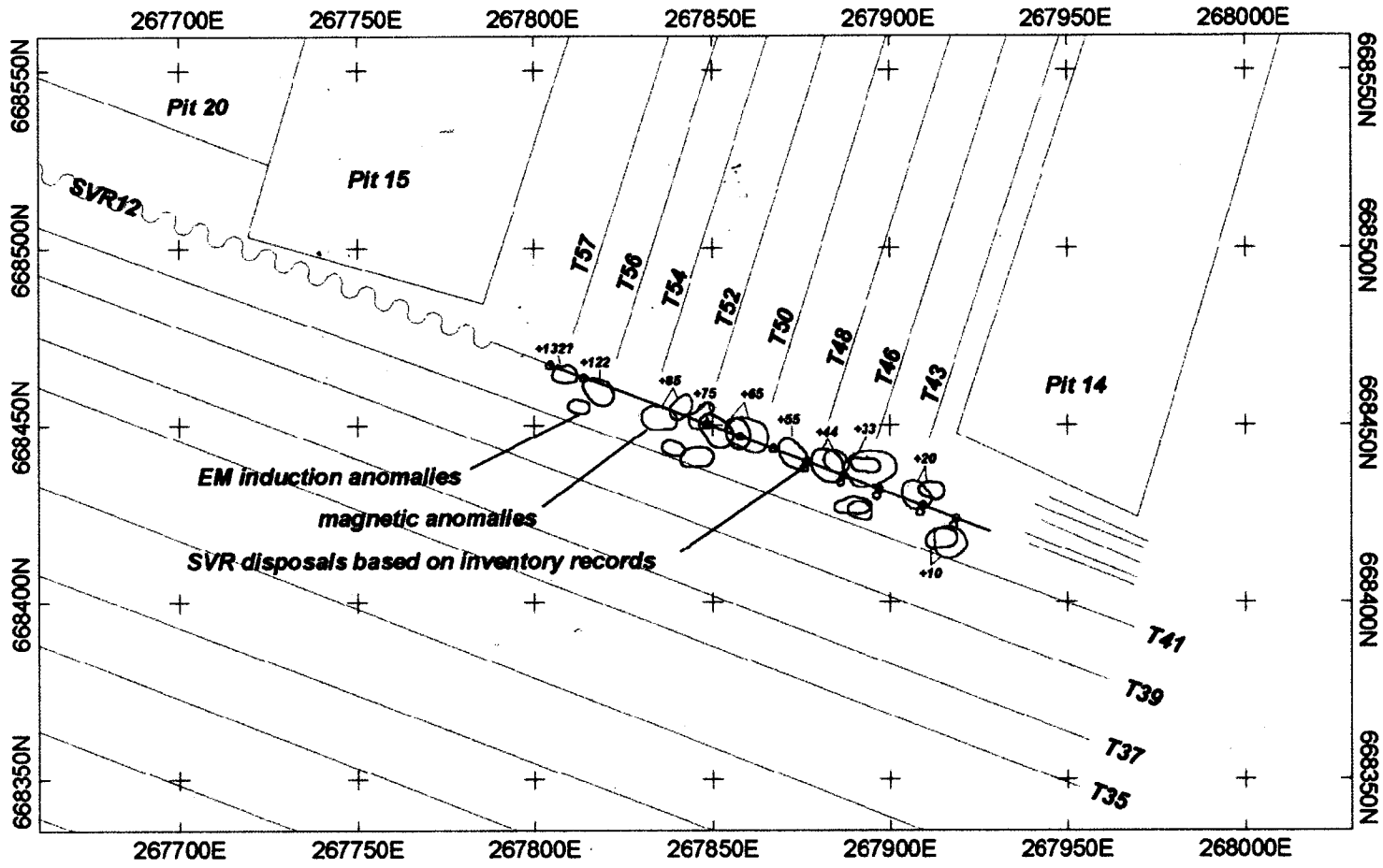

Figure 3-52. Geophysical interpretation summary for Soil Vault Row-12. Labeled anomalies are interpreted to correspond with specific inventory items based on their position and spacing along the trench line. Unlabeled anomalies are interpreted to represent objects within the adjacent Trench 41.

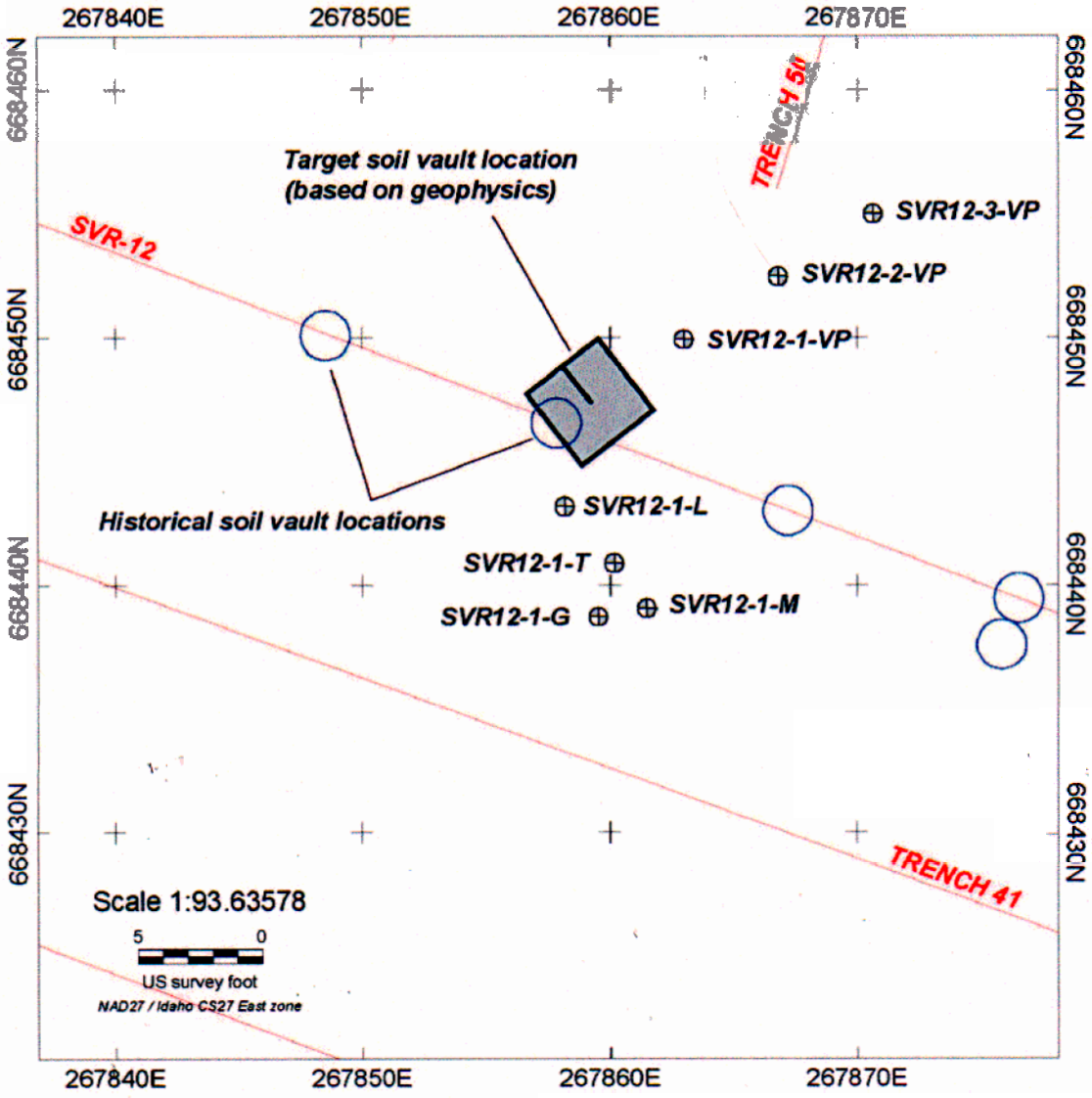

Figure 3-53. Proposed location of Soil Vault Row-12 Type B probe clusters.